Process Evaluation Section

Simulation of a Novel Fluid Catalytic Cracker Process Technology

Problem/Opportunity

Process Innovators Inc. (PII), a small entrepreneurial business, is developing an innovative, more efficient staged fluid catalytic cracker (FCC) technology. The technology has exceptional potential to substantially improve conventional FCC technology. PII is building a demonstration unit at a refinery in Utah. In order to speed up commercialization after the performance demonstration, PII needs a fundamental understanding of the impact of operating and design parameters on performance and the design capability to optimize and project system performance to larger sizes. These objectives can be readily accomplished by developing a computational fluid dynamic (CFD) simulation of the low-profile fluid catalytic cracker concept (LPFCC) process. The development and validation of such a simulation will also provide an opportunity to achieve a major scientific objective: advancing the status of ANL's state-of-the-art CFD code and demonstrating its capability for analyzing complex multiphase reacting flow systems. The flows in the staged risers of the LPFCC unit will essentially comprise mixing zones where the interactions of hydrodynamics, heat transfer, and cracking kinetics are magnified.

Approach

ANL will modify its multiphase, integrated cracking flow (ICRKFLO) code to simulate the multistage LPFCC system. Performance data acquired from the demonstration unit over a limited parameter range of temperature, catalyst/oil mass ratio, catalyst activity, etc., will provide the requisite database to validate the FCC simulation. The validated CFD-LPFCC process model will then be used to (1) evaluate/interpret data that will be derived from extended operation of the demonstration unit, and (2) conduct parametric, sensitivity, and optimization studies in support of commercialization activities.

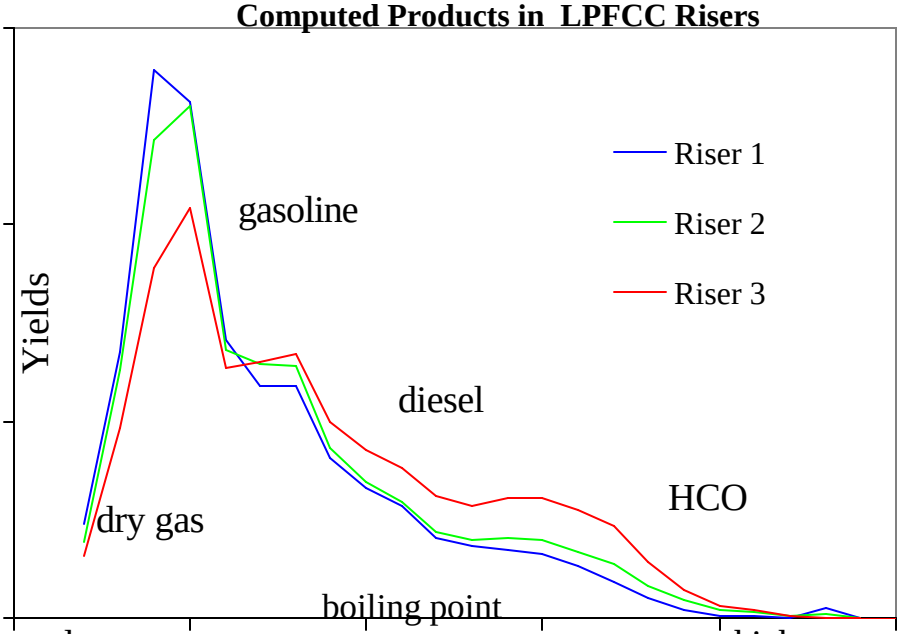
Results

Technical progress accomplished to date includes (1) development of a simulation for both the pilot- and demonstration-scale LPFCC units, (2) determination of a set of preliminary kinetic constants from the pilot-scale LPFCC unit, and (3) a parametric/optimization study of conceptual LPFCC configurations. The conceptual design studies were performed to more clearly define the gains achievable from FCC staging.

Future Plans

Construction of the pilot plant is underway. Upon completion, a series of tests will be conducted by PII in accordance with a test matrix that will be generated with the aid of the simulation that has been developed. The data obtained will be used to complete validation of the LPFCC FCC model. ANL will then assist PII in conducting extensive parametric, sensitivity, and scale-up studies to help speed up commercialization.

Computed Products in LPFCC Risers



An LPFCC Unit Under Construction